

THE WEATHER AND CIRCULATION OF MAY 1954¹

A Circulation Reversal Effected by a Retrogressive Anticyclone During an Index Cycle

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THE CIRCULATION REVERSAL FROM APRIL TO MAY

It has been demonstrated by Namias [1] that monthly mean anomalies of temperature, precipitation, and height in the United States and adjacent areas persist less from April to May than for any other pair of months during the year except October-November. In fact, during the past decade these anomalies have shown more tendency for reversal than for persistence during the April-May period. This year the April-May reversal was even more marked than usual, not only for the United States but also for the circulation of most of the Northern Hemisphere. It will be recalled that April 1954 was characterized by a confluent jet stream and high index circulation over North America and the Atlantic, downstream from a low index blocking pattern in the Pacific [2]. This month's circulation was almost diametrically opposite, as illustrated by the mean charts for sea level (Chart XI), 700 mb. (fig. 1), and 200 mb. (fig. 2).

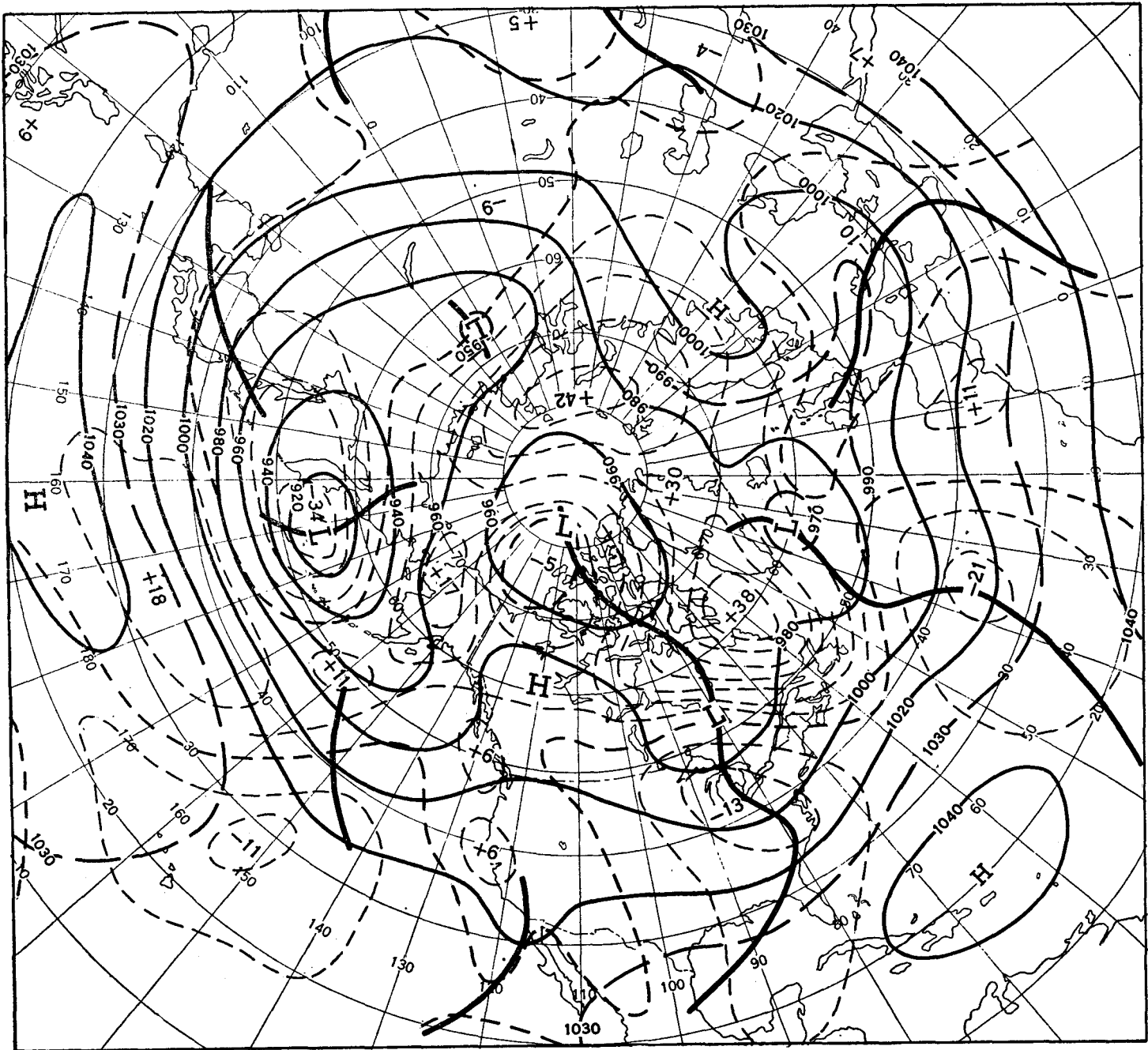
At all levels the most prominent feature of May 1954 was the persistence of ridge conditions over southern Greenland and eastern Canada, a region occupied by an abnormally deep trough during the preceding month. Maximum positive anomalies of 8 mb. at sea level and 380 ft. at 700 mb. were observed in Davis Strait, the latter value having been exceeded only once in that area in May during our 22-year period of record. As is usually the case, strong centers of negative height anomaly were located southeast and southwest of the block, the former near the Azores and the latter near the Great Lakes. These were part of a broad band of negative height departures at middle and low latitudes stretching from the Continental Divide of the United States to the eastern Atlantic, in the same zone that had been dominated by above normal heights at 700 mb. during April. The most striking change in the Pacific circulation occurred in the Bering Sea, where an abnormally deep Low (−340 ft. at 700 mb. and −12 mb. at sea level) replaced the strong blocking High of the previous month.

These abrupt transitions in large-scale circulation regimes are highlighted in figure 3, which maps the difference in mean 700-mb. height departure from normal

between April and May of 1954. Inspection of the complete file (from 1933 to date) of charts showing this month-to-month anomalous height change reveals that this year's anomalous change of −680 ft. in the Bering Sea was the largest (regardless of sign) ever observed from April to May in any part of the Northern Hemisphere. The magnitude of this year's change in Davis Strait (+620 ft.) was exceeded in 1948 in the Pacific but never in the Atlantic or North America. Figure 3 also brings into sharp focus the blocking action which caused heights to rise more rapidly than normal from April to May throughout Canada while they actually fell (contrary to the normal trend) in most of the United States and adjacent oceans. In the mid-Pacific, on the other hand, the zonal westerlies increased markedly as large anomalous height falls in the north were compensated for by rises in the south. It is interesting to note that anomalous height changes in the western United States and eastern Pacific were relatively small, compared to those in other parts of the hemisphere, in agreement with the fact that April-to-May persistence during the past 20 years has been greater in this area than elsewhere [3].

The marked change in circulation pattern from April to May 1954 is also illustrated in striking fashion in figure 4A, giving the distribution of geostrophic wind speeds computed from figure 1. A single well-developed axis of maximum wind speed at 700 mb. (solid arrow) extended across middle latitudes during May from the Asiatic Coast into the Mediterranean, near 45° N. in the Pacific and 35° N. in the Atlantic. The corresponding position of this principal 700-mb. jet stream during April is delineated by the dashed arrow in figure 4A. Comparison of the solid and dashed arrows indicates that the westerly jet stream in the Pacific was 5° to 10° farther north in May than in April, but elsewhere it was displaced southward, by some 5° in the United States and as much as 20° in the eastern Atlantic. Wind speeds along the jet axis were also drastically altered during this April-May reversal, increasing from 25 to 45 m. p. h. in the Pacific but decreasing from 35 to 20 m. p. h. in the United States and the Atlantic. As a result this month's wind speeds were below normal throughout southern Canada and the northern Atlantic (fig. 4B), where they had been above

¹ See Charts I–XV following p. 140 for analyzed Climatological data for the month.



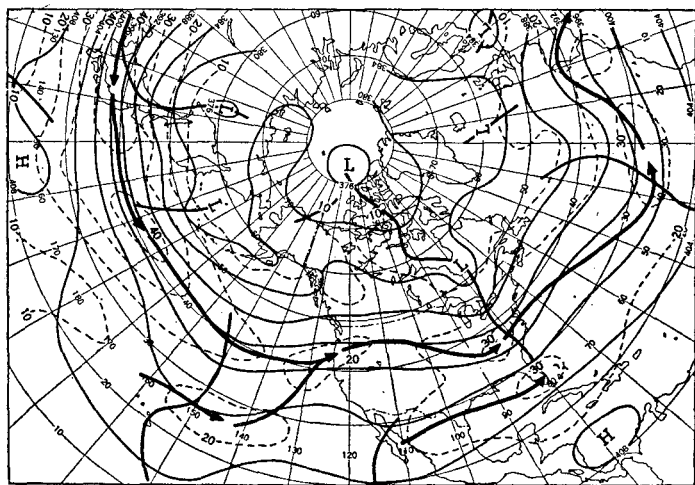


FIGURE 2.—Mean 200-mb. contours (in hundreds of feet) and isotachs (dashed, in meters per second) for May 1-30, 1954. Solid arrows indicate the average position of the 200-mb. jet stream which was stronger than, and north of, normal in the Pacific, but relatively weak and well to the south in eastern North America and the Atlantic.

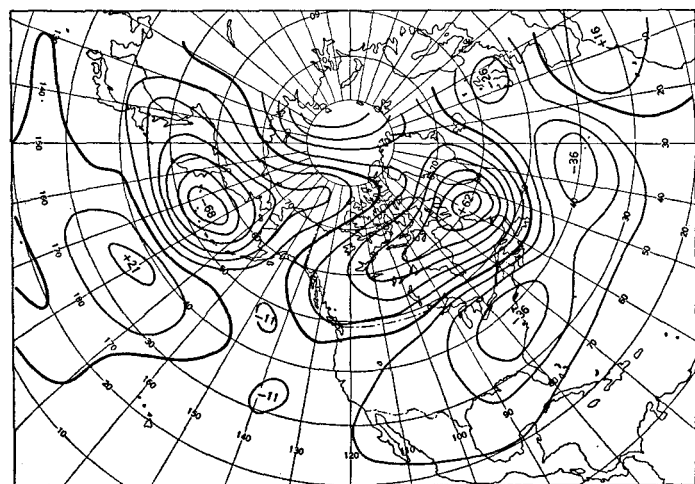


FIGURE 3. Change in mean 700-mb. height departure from normal from April to May 1954. The lines of equal anomalous height change are drawn at 50-ft. intervals with the center labeled in tens of feet. Changes in Bering Sea and Davis Strait were of record magnitude. Note weakening of westerlies at middle latitudes of North America and Atlantic due to blocking.

any time of the year, they are most frequent in late February or early March [5]. This year, however, no clear cut or prolonged index cycle was apparent during any of the winter months; apparently the primary cycle was not initiated until April.

The lower curve in figure 5 shows the time variation of 5-day mean values of the 700-mb. zonal (temperate) index computed twice-weekly from average heights at latitudes 35° N. and 55° N. in the Western Hemisphere. The curve starts with the index for the 5 days centered on March 15, the lowest value observed during 1954 up to that time. Prior to this date the 1954 graph showed a series of irregular short-period fluctuations, but thereafter a definite long-period index trend was clearly discernible. For the first $2\frac{1}{2}$ weeks of this period the index increased steadily, reaching a high of 11.9 m. p. s. on April 2, the beginning of the index cycle proper. During the next 7 weeks the index

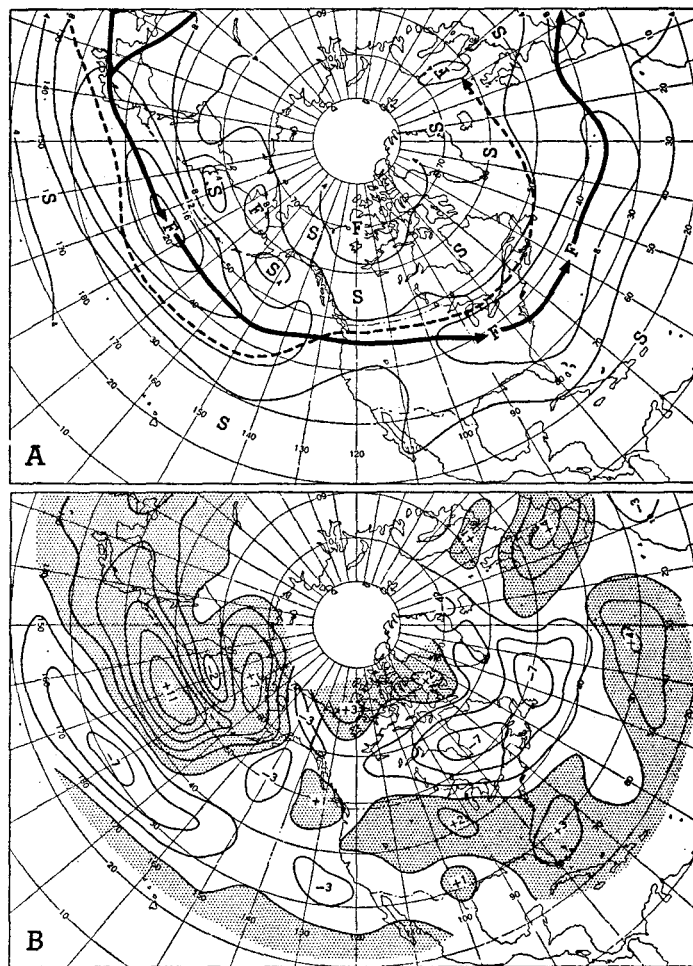


FIGURE 4.—(A) Mean 700-mb. isotachs and (B) departure from normal wind speed (both in meters per second) for May 1-30, 1954. Solid arrows indicate average position of the 700-mb. jet stream during May, while dashed arrows show its position during April. The jet stream in the Pacific was 5° to 10° farther north in May than in April but elsewhere it was displaced southward.

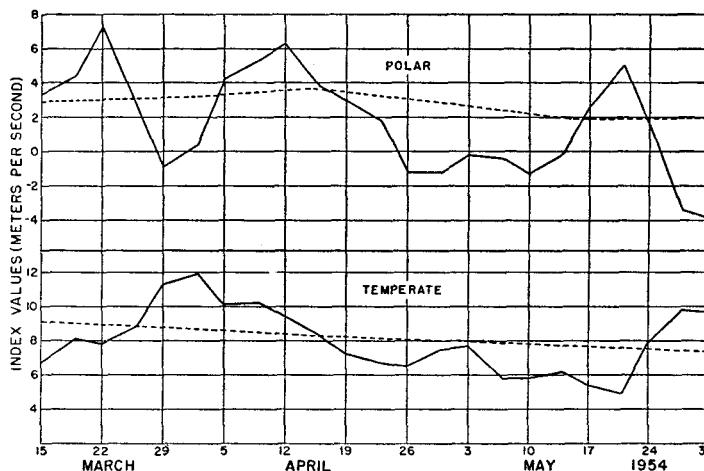


FIGURE 5.—Average strength of 700-mb. westerlies over the Western Hemisphere for polar (55° N.- 70° N.) and temperate (35° N.- 55° N.) regions. Solid lines connect 5-day mean index values (plotted at middle of 5-day period and computed twice-weekly), while dashed lines show variation of corresponding normal indices. Note long-period decline of the zonal (temperate) index from April 2 to May 21.

declined in irregular fashion to a minimum of 4.9 m. p. s. (2.7 m. p. s. below normal) in the 5-day period centered on May 21. This was the lowest value of the zonal index observed during any 5-day mean period of the first half of 1954. During the last ten days of May the index increased rapidly to values well above normal, thereby terminating the index cycle.

Figure 6 depicts more completely the variation of the 5-day mean westerlies at 700 mb. during this index cycle. As the zonal index rose during the latter half of March the major westerly belt moved northward. This northward shift continued during the first half of April, despite the fact that the index was already declining. It was not until the second half of April that the axis of maximum west wind speed moved southward, as it normally does during the falling index stage of the index cycle [4], from 52° N. on the 16th to 38° N. on the 29th. There was little change in the latitude of maximum westerlies during the next three weeks as the index continued to drop; but the intensity of the west wind maximum diminished to a minimum of 6 m. p. s. on May 21, the low point of the cycle. Thereafter the zonal index increased as the westerlies shifted northward and rapidly intensified to a maximum of 16 m. p. s. on May 28.

The index cycle just described was of unusual length and of great intensity. According to Namias [5] the intensity of an index cycle appears to be largely determined by the reservoir of cold air in polar regions preceding its onset. Reference to figure 1 of last month's article [2] indicates that temperatures in the lower troposphere during April averaged far below normal in most of Canada and Alaska. This cold air was contained in the north by fast westerlies during April; but it came south in great force when the westerlies weakened in May, thereby contributing to the strength of this year's index cycle.

Figure 5 shows that the 5-day mean zonal index was below normal during all but the last week of May. For the month as a whole the zonal index at 700-mb. averaged 0.8 m. p. s. below the May normal, in contrast to its value of 0.7 m. p. s. above normal during April. This was the

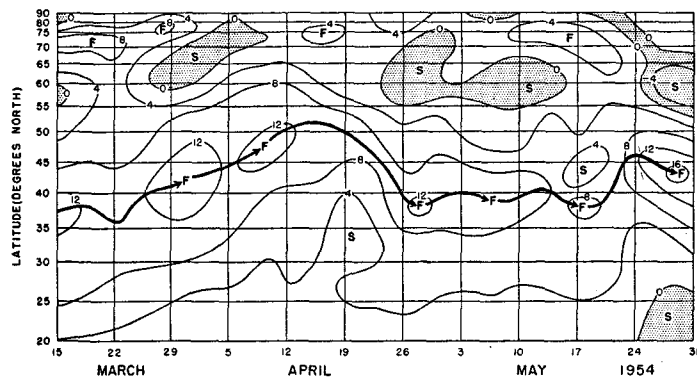


FIGURE 6.—Time-latitude section of 5-day mean zonal wind speed in the Western Hemisphere in meters per second at 700-mb., corresponding to period shown in figure 5. The latitude of the axis of maximum west wind speed (heavy arrows) increased from mid-March to mid-May but then decreased to low values during May. Note easterlies (shaded) in polar regions.

first month with the zonal index in the Western Hemisphere below normal since January 1954 [6] and only the second since April 1953 [7]. The low index nature of the May circulation was even more pronounced at sea level, as shown by the mean pressure profile of figure 7. Pressures averaged above normal in the northern half of the hemisphere and below normal in the southern half. In other words the polar anticyclones grew at the expense of the subtropical anticyclones, in accordance with the classical concept of low index [4].

Thus the contrast between the circulation patterns of April and May may be thought of as the difference between high and low index. This was essentially true of North America and the Atlantic, which dominate the zone (0° westward to 180°) used in computing all data in figures 5, 6, and 7. In the Pacific however, the circulation change from April to May was opposite in character. Here low index conditions during April were replaced by a high index circulation in May, as indicated in figures 1 to 4. This again points up the danger, emphasized in previous articles [2, 6] of using a hemispheric index to define a regional circulation pattern.

THE BLOCKING ANTICYCLONE

According to Namias [5] each primary index cycle is usually associated with a strong wave of Atlantic blocking, characterized by a tendency to form warm anticyclones in high latitudes and cold cyclones in low latitudes. Not only did such a warm blocking anticyclone form at the beginning of this year's index cycle, but it dominated the hemispheric circulation for almost two months thereafter.

The track of the positions of this anticyclone on a series of 15-day mean 700-mb. charts is shown by the dashed line in figure 8. The High center, delineated by open circles, was over the British Isles during the second half of April, near northern Labrador during the first half of May,

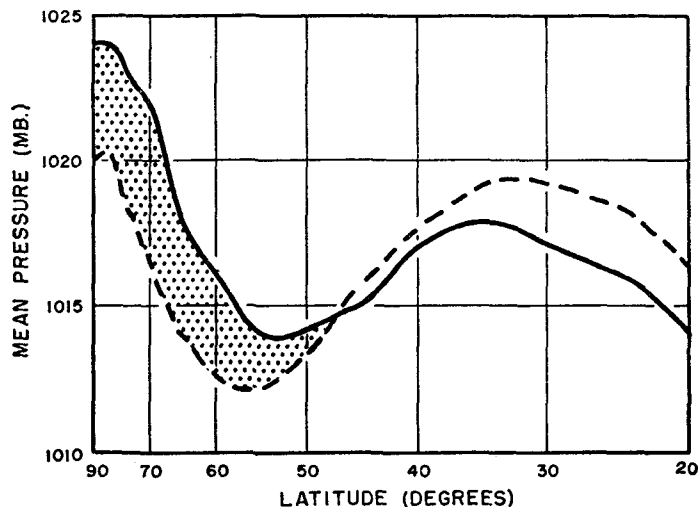


FIGURE 7.—Mean sea level pressure profile in the Western Hemisphere for May 1-30, 1954 with normal May profile dashed. Note positive anomaly of pressure north of 48° N. (shaded area) and negative anomaly to the south.

and over western Canada during the second half of May. A somewhat similar retrogressive 15-day mean anticyclone during the winter of 1949-50 was formed by several separate 5-day mean High centers [8]. This year, however, the 15-day mean center was composed essentially of only one 5-day mean system.

The remarkable track of this 5-day mean anticyclone at the 700-mb. level is given by the solid curve in figure 8, connecting the centers denoted by crossed circles. The High first appeared just east of Bermuda during the period centered on April 9. For a week and a half it was embedded in a fast westerly steering current and moved rapidly northeastward along a rather common trajectory. After stagnating near the British Isles for a week, it began to recurve toward the northwest in a great cyclonic loop. Upon reaching latitude 60° N. it retrograded steadily for almost two weeks across the Denmark and Davis Straits into Hudson Bay. Up to this point its continuity, although unusual, could clearly be followed on our series of twice-weekly overlapping 5-day mean charts. However, for a week following the period centered May 14 only broad ridge conditions could be detected in Canada, and a separate High cell did not reappear on our charts until the 5-day period centered on May 24. This portion of the track has therefore been dotted in figure 8. During the last week of May the anticyclone was again well defined as it moved through western Canada, first northwestward and then northeastward.

On a daily basis the continuity of the anticyclone was not so clear since several eastward-moving daily systems made up the retrograding High, as is usually the case. It is rare, however, for a blocking anticyclone, even on a 5-day mean basis, to retrograde bodily from England into western Canada, as this one did. It is more customary for blocking

to spread westward by means of successive intensification of ridges and weakening of troughs upstream, as occurred for example during the pronounced blocking wave of January 1954 [6].

The unusual track of the 5-day mean anticyclone of the spring of 1954 can be related to the behavior of the hemispheric indices shown in figure 5. While the High moved eastward, from April 9 to 16, the zonal index giving the strength of the temperate westerlies was above its seasonal normal. During the prolonged retrogression, however, from April 20 to May 24, the zonal index was well below normal. Moreover, the polar westerlies (55° N.- 70° N.) were also below normal during the entire period of retrogression except during the week of uncertain continuity from May 16-23. In fact, easterlies actually prevailed at the 700-mb. level in the polar region from April 25 to May 14, as shown by negative index values in the upper curve of figure 5 and by negative (shaded) values of westerly wind speed in figure 6.

The continuity of the anticyclone is even clearer when traced on a series of twice-weekly 5-day mean charts of sea-level pressure or 700-mb. height anomaly. In terms of either of these elements the center could be followed on every chart of the series from April 9 to May 31, including the two maps centered on May 17 and May 21 when the anticyclone at 700 mb. lost its separate identity. This is indicated in table 1 which gives the central intensity of each element on each 5-day period that a closed center was present. At the 200-mb. level the center of the anticyclone was much less distinct; on almost half the maps only a strong ridge was discernible. In order to avoid confusion the tracks of the centers of sea-level pressure, 700-mb. height anomaly, and 200-mb. height have not been included in figure 8. They generally coincided quite closely with the track of the anticyclone at 700 mb. with the centers of the first two elements slightly to the north and of the last slightly to the south of the corresponding 700-mb. High center.

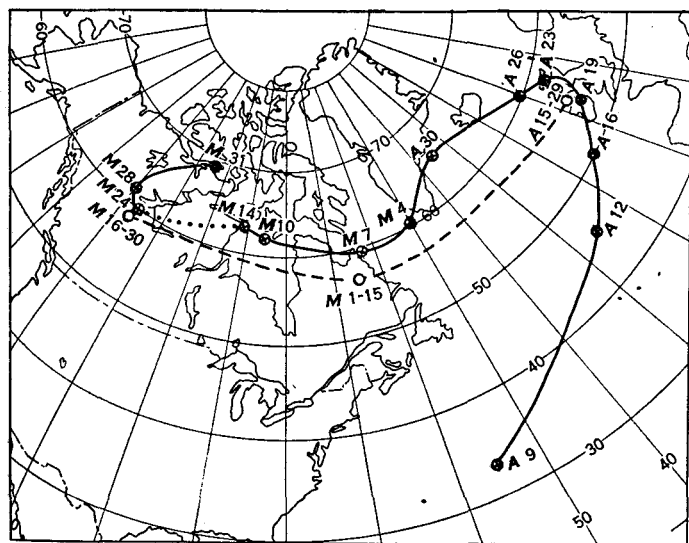


FIGURE 8.—Trajectory of the 700-mb. anticyclone of the spring of 1954, as determined from a series of 15-day mean charts (dashed track) and 5-day mean charts (solid track except dotted in region of uncertain continuity). Open circles locate the center of the 15-day mean anticyclone starting with the period April 15-29 and ending with the period May 16-30. Crossed circles indicate the center on successive 5-day mean maps (computed twice-weekly) from the period centered April 9 (A 9) to the period centered May 31 (M 31).

TABLE 1.—Central intensity of 700-mb. height and its anomaly, sea-level pressure, and 200-mb. height along the track of the 5-day mean anticyclone of the spring of 1954 (shown in fig. 8)

5-day mean period	700-mb. height (ft.)	700-mb. height anomaly (ft. above normal)	Sea-level pressure (mb.)	200-mb. height (ft.)
April 7-11.....	10,500	490	1033	-----
10-14.....	10,420	550	1035	39,100
14-18.....	10,480	750	1038	39,200
17-21.....	10,160	500	1030	39,300
21-25.....	10,050	420	1028	38,300
24-28.....	10,060	500	1031	-----
April 28-May 2.....	10,090	680	1036	38,500
May 5-9.....	10,110	750	1033	-----
8-12.....	10,170	860	1036	39,600
12-16.....	10,100	640	1032	-----
15-19.....	9,830	360	1025	-----
19-23.....	-----	270	1021	-----
22-26.....	9,950	240	1023	-----
26-30.....	10,000	110	1025	38,700
May 29-June 2.....	10,090	320	1027	38,800
		570	1030	39,000

Table 1 shows that the 700-mb. height at the center of the anticyclone fell almost 500 ft. during April as it moved

fluctuation of the general circulation. It is also noteworthy that Atlantic blocking activity for the periods 1933–1940 and 1945–1949 was more frequent during May than during any other month of the year [9].

THE WEATHER

The reversal in circulation from April to May produced a marked change in temperature regime in the eastern two-thirds of the United States. Whereas monthly mean temperatures had been much above normal in this area in April [2], they averaged from 2° to 7° F. below normal during May (Chart I-B). Greatest negative departures were observed in the Upper Mississippi Valley and in the Southeast. The first decade of May was one of the coldest on record in Minnesota, where a heavy snowcover ranging up to 15 inches was reported around Lake Superior on the 10th. Minimum temperatures on May 1 and 2 in Montana and during the next few days at many stations in the Mississippi Valley were the coldest ever recorded for May. In the Southeast record low temperatures for so late in the season were reported on May 22 at Jacksonville, Fla. (51°), Birmingham, Ala. (41°), and Augusta, Ga. (42°).

This cold weather can be readily associated with the monthly mean 700-mb. chart (fig. 1), which shows that the eastern two-thirds of the United States was dominated by stronger than normal northerly wind components, below normal heights, and cyclonic curvature at the 700-mb. level. At sea level (Chart XI) the nose of high pressure projecting southeastward from central Canada through the upper Mississippi Valley into the Southeast well delineates the axis of coldest air at the surface. Much of this cold air was carried into the country from the frozen Hudson Bay region by northeasterly winds, relative to normal, at sea level (Chart XI inset). The severity of the cold outbreaks in the United States can also be attributed to the presence of abnormally cold air in the Canadian source region during the preceding month [2], a situation similar to that which occurred in November 1951 [10, 11].

West of the Continental Divide temperatures generally averaged above normal during May, with greatest departure (6° F.) in central Nevada. On the 19th and 20th maximum temperatures rose to record levels in the West, ranging from 93° in Glasgow, Mont., to 104° in Needles, Calif. Warm weather in this region during May was accompanied by a stronger than normal thermal trough at sea level, above normal heights and weak westerlies at 700 mb., and an abnormally deep trough in the eastern Pacific. Along the immediate coast temperatures averaged slightly below normal because the cool sea breeze was intensified by abnormal warmth in the interior valleys.

The predominance of blocking activity in Canada and a strong cyclonic circulation to its south were responsible for a good deal of storminess (Chart X) and precipitation (Chart III) in the eastern two-thirds of the United States. Above normal rainfall amounts were recorded all along the

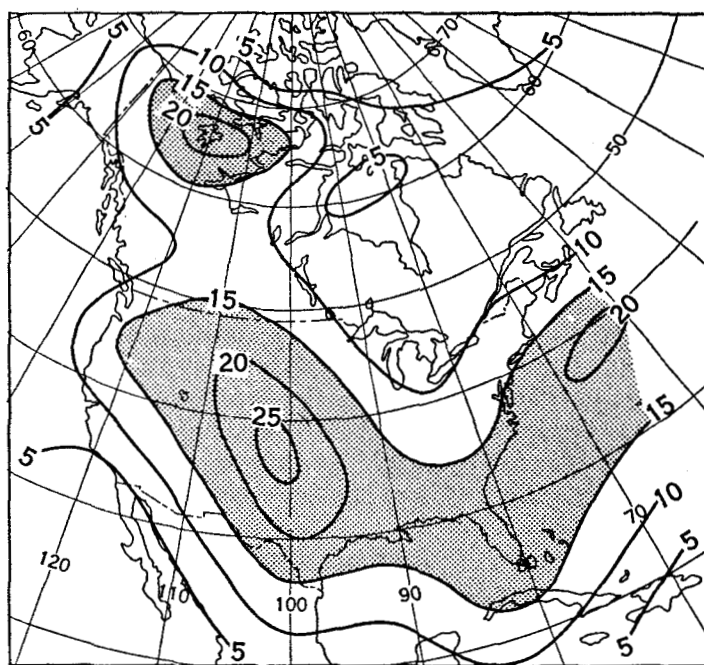


FIGURE 10.—Number of days in May 1954 with surface fronts of any type (within squares with sides approximately 430 nautical miles). Frontal positions taken from *Daily Weather Map*, 1:30 p. m. EST. Note great frequency of fronts in Texas Panhandle.

Atlantic Coast (with a few exceptions) in southerly flow ahead of the 700-mb. trough and its related abnormally deep mean trough at sea level. An unusually large number of daily cyclones moved up along the coast, and some recurved into New England or the Maritime Provinces because of the block. On May 16 one of these storms, produced 5.74 inches of rain in 24 hours at Boston, Mass., a new 24-hour record. Total rainfall during May at Boston was 13.38 inches, almost 5 times the normal amount and 1 inch more than the total recorded in any month of the year in a long period of record dating back to 1818. Heavy precipitation throughout New England was favored by strong southeasterly wind components, relative to normal, on the monthly mean charts for both sea level and 700 mb.

A larger area of above normal precipitation during May extended from southern New Mexico northeastward to Missouri and thence northward to the Canadian border. This area included west Texas and Oklahoma, where a prolonged drought had been broken during April [2]. The additional rains during May resulted in reports at the month's end of the best moisture situation in many years. Also included in the wet area were central and southern Iowa where many small streams were overflowing at the close of the month. Floods were also reported in parts of New Mexico on the 18th when 3 to 4 inches of rain fell overnight.

Heavy precipitation in Texas and neighboring States was related to an unusual concentration of surface fronts in this area. Figure 10 shows that fronts were located in the Texas Panhandle on as many as 25 days of the month.

Prevailing southeasterly flow at sea level carried warm moist air at low levels from the Gulf of Mexico to overrun colder polar air in these quasi-stationary frontal zones. Farther northeast most of the precipitation was cyclonic in origin as numerous storms traversed the Central and Northern Plains and the Upper Mississippi Valley (Chart X).

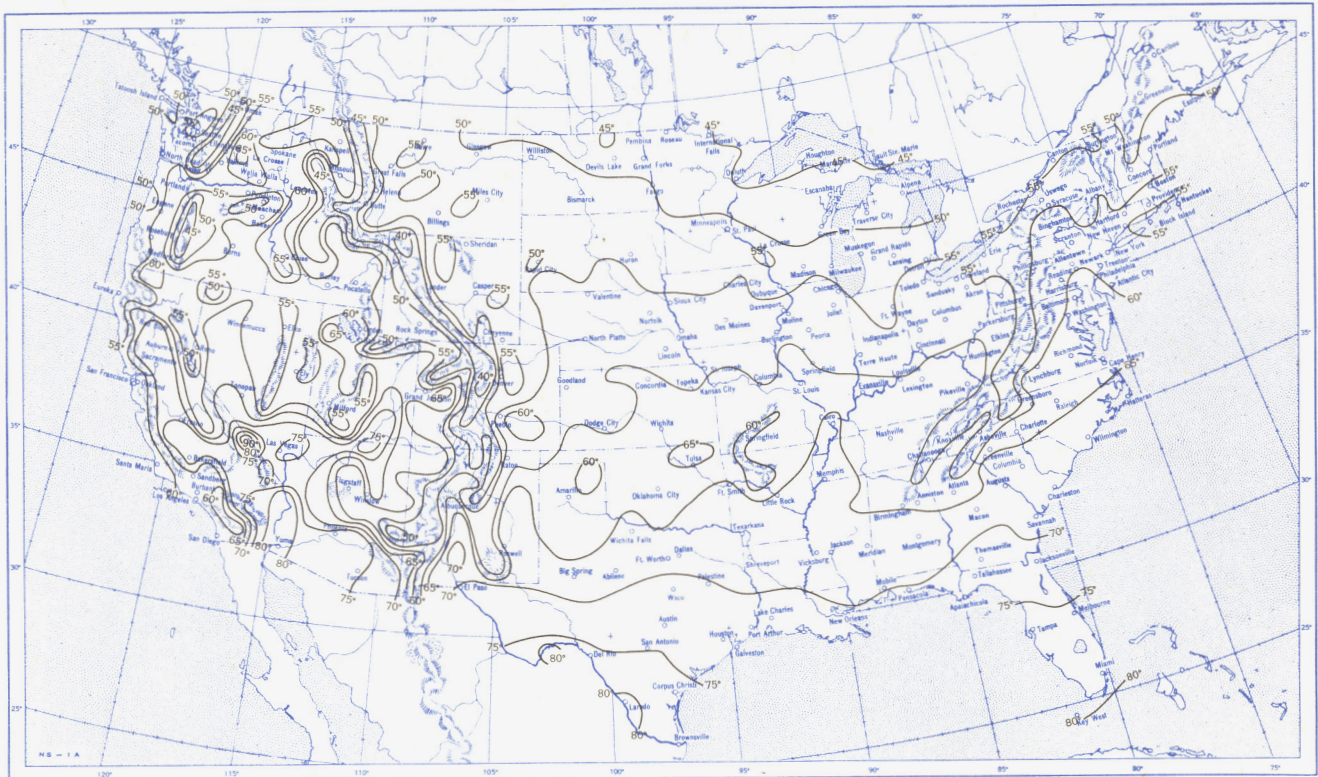
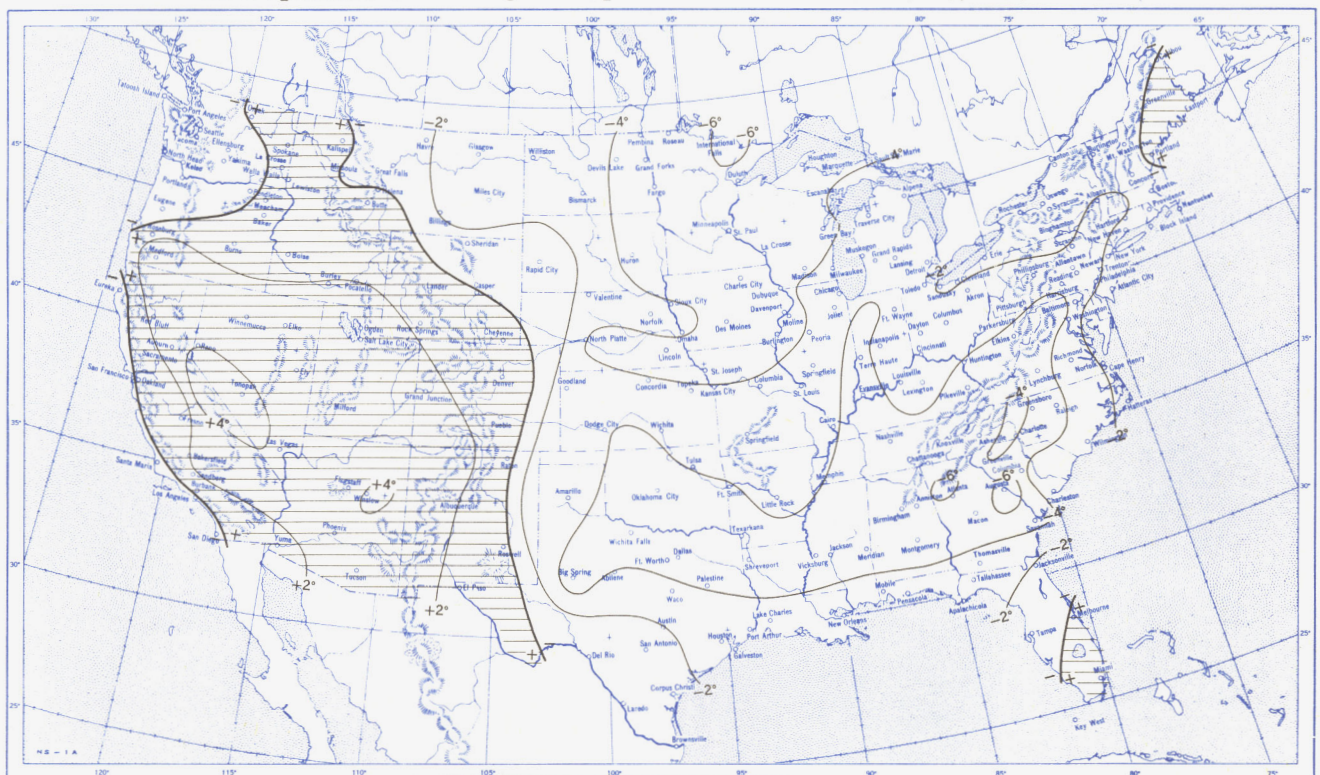
Between these two bands of above normal precipitation subnormal amounts fell in most of the area between the Appalachians and the Mississippi. This region was dominated by stronger than normal northwesterly flow just west of the trough line at 700 mb. (fig. 1). At sea level dry northerly flow and anticyclonic conditions prevailed in the mean (Chart XI). The complete absence of migratory cyclones (Chart X) and the small frequency of surface fronts (fig. 10) were also concomitants of deficient precipitation in this area.

Dry weather was also prevalent in the western part of the United States from the Great Plains to the Pacific Coast. In California and Nevada statewide precipitation averaged only 16 and 17 percent of normal respectively. This region was dominated by stronger than normal ridge conditions at the 700-mb. level and by a thermal trough at sea level. The normal influx of moisture from the Pacific was greatly weakened by the prevalence of easterly wind components, relative to normal, at both sea level and 700 mb. in most of the eastern Pacific and western North America. As a result only one migratory cyclone entered North America from the Pacific all month long (Chart X).

An interesting sidelight of this year's weather has been the pronounced 2-month cycle of monthly mean temperature in the eastern two-thirds of the United States. Surface temperatures in most of this area averaged near to below normal during January 1954, above and much above during February, near to below normal during March, above to much above during April, below and much below during May, and near to much above during June. Relatively cool weather during the months of January, March, and May was associated with recurrent blocking activity, while warm weather during the other months of the first half of the year was accompanied by fast westerly flow along the United States-Canadian border. No explanation for these large-scale oscillations or indications of their future duration is available at present.

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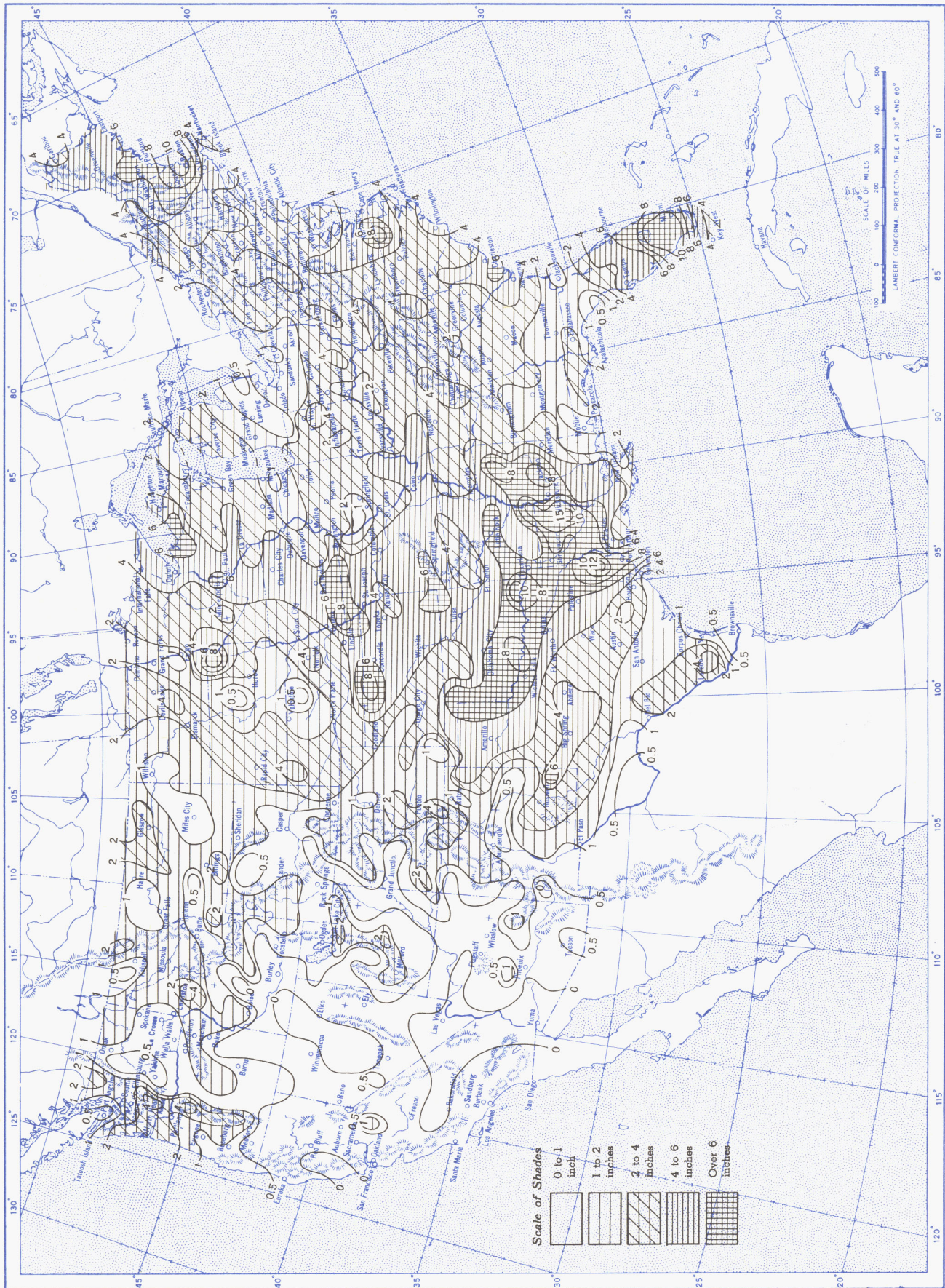
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Chart I. A. Average Temperature ($^{\circ}\text{F.}$) at Surface, May 1954.B. Departure of Average Temperature from Normal ($^{\circ}\text{F.}$), May 1954.

A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.

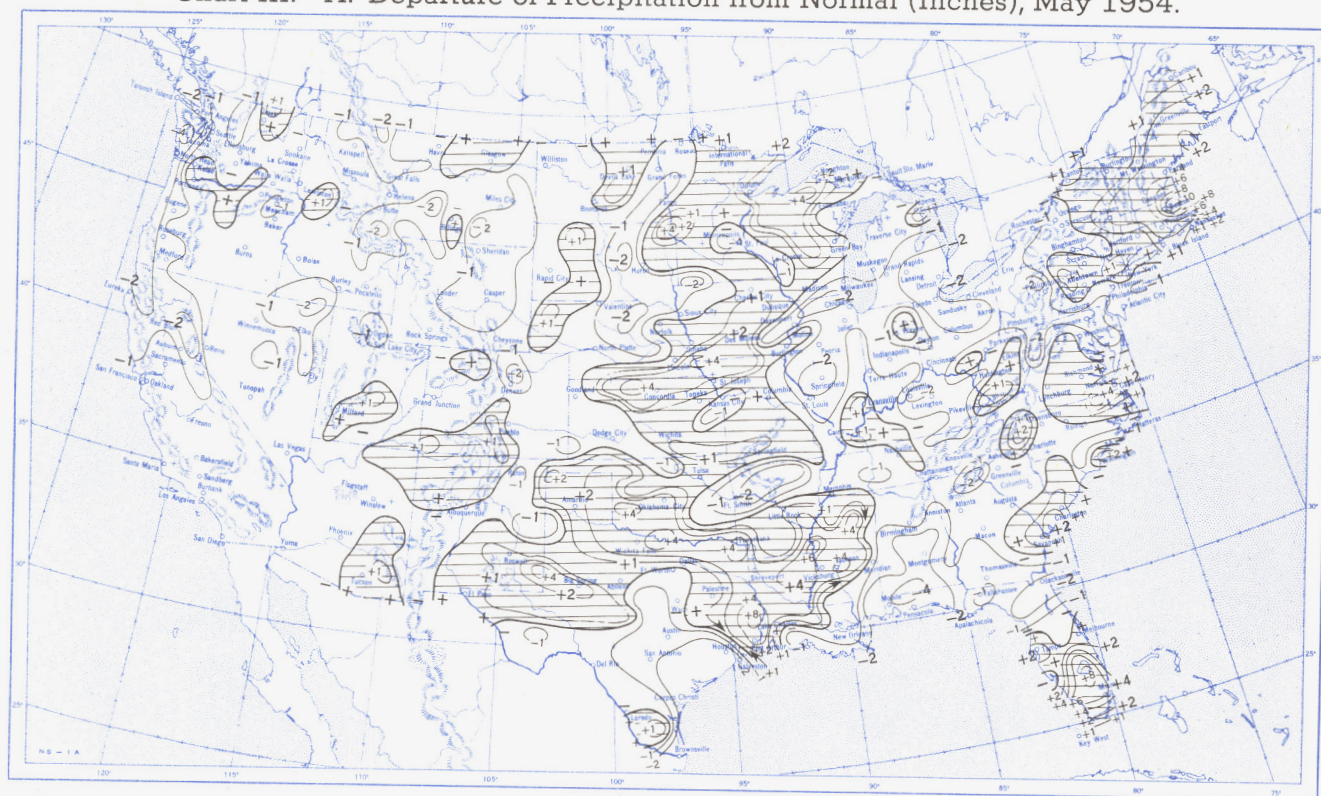
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

Chart II. Total Precipitation (Inches), May 1954.

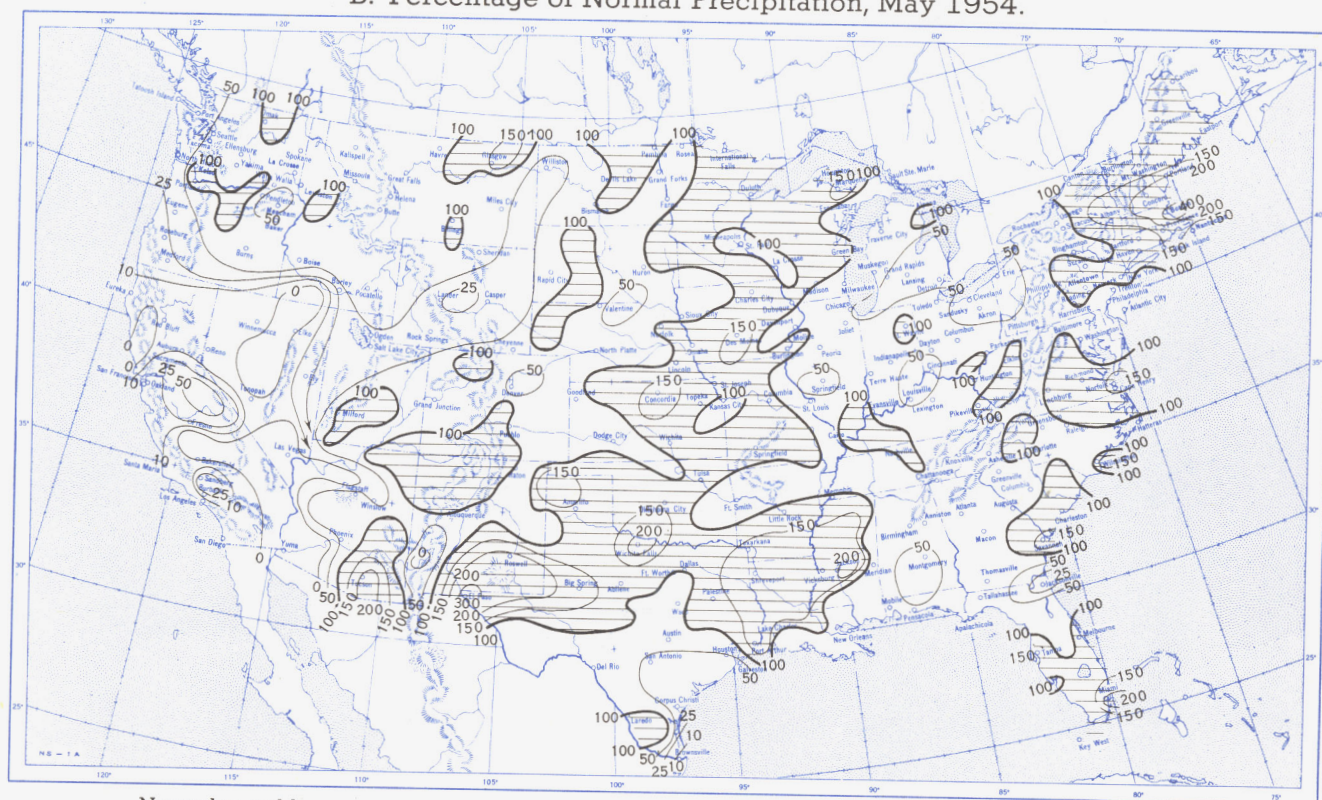


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), May 1954.

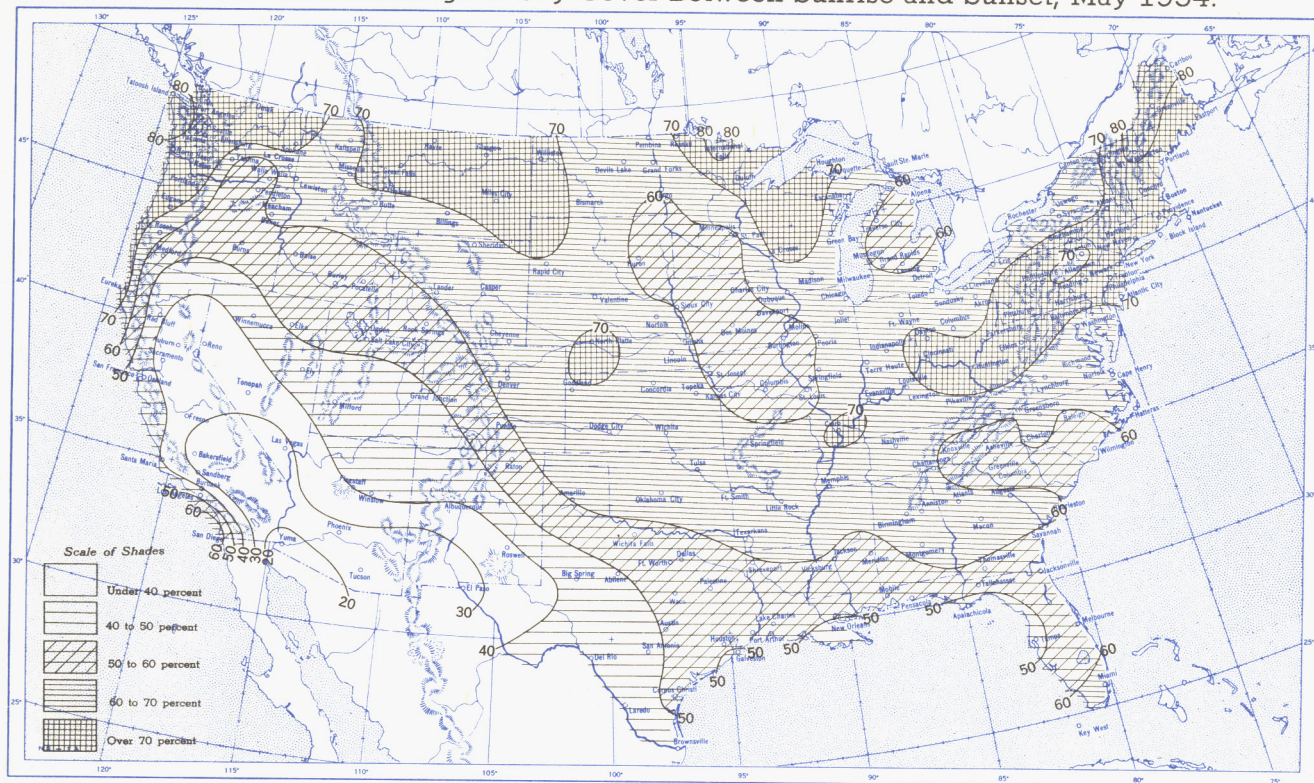


B. Percentage of Normal Precipitation, May 1954.

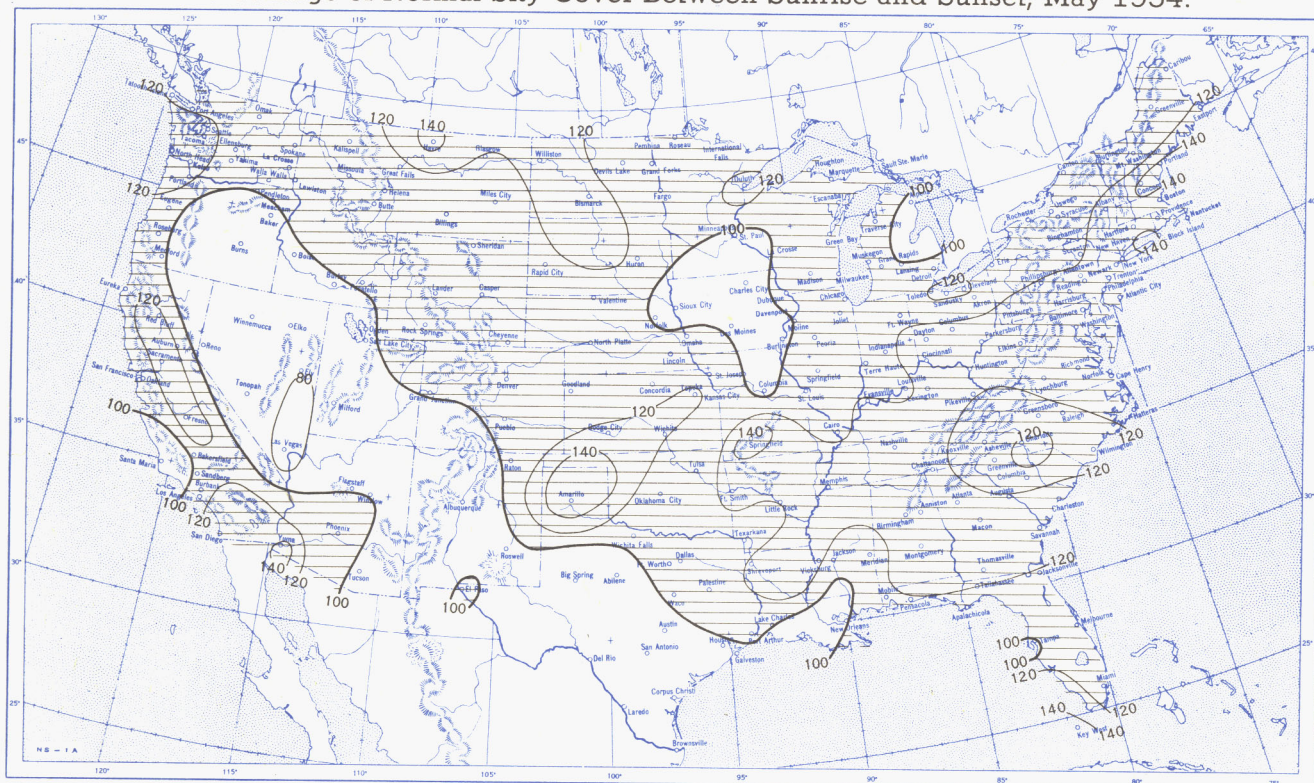


Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, May 1954.

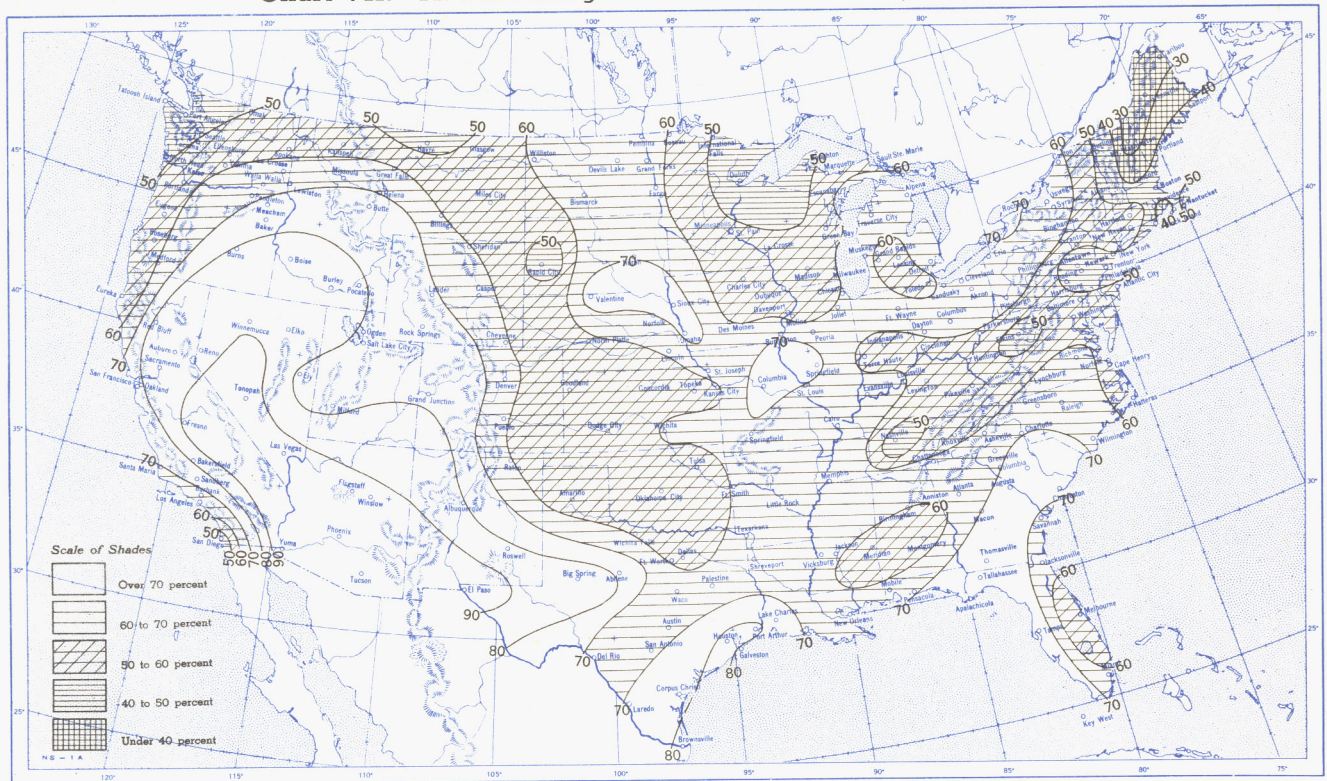


B. Percentage of Normal Sky Cover Between Sunrise and Sunset, May 1954.

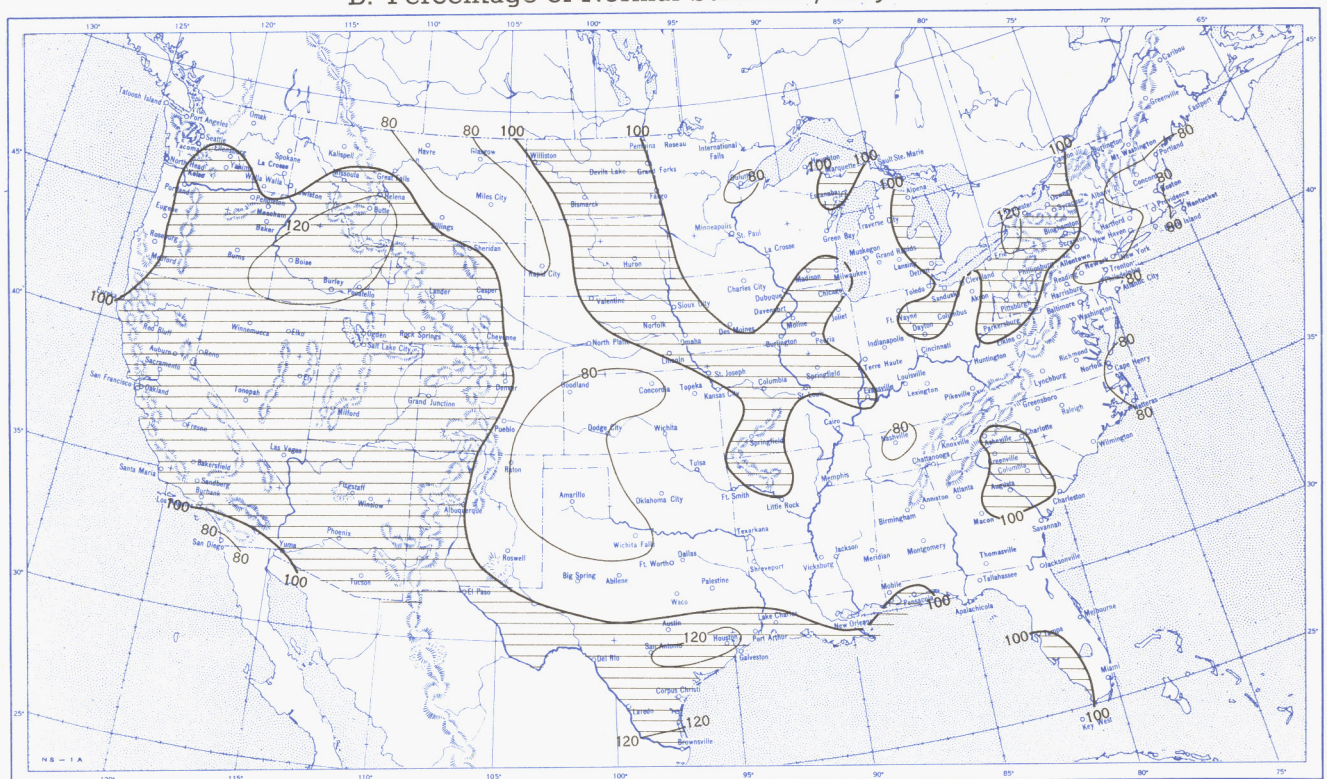


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, May 1954.



B. Percentage of Normal Sunshine, May 1954.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, May 1954. Inset: Percentage of Normal Average Daily Solar Radiation, May 1954.

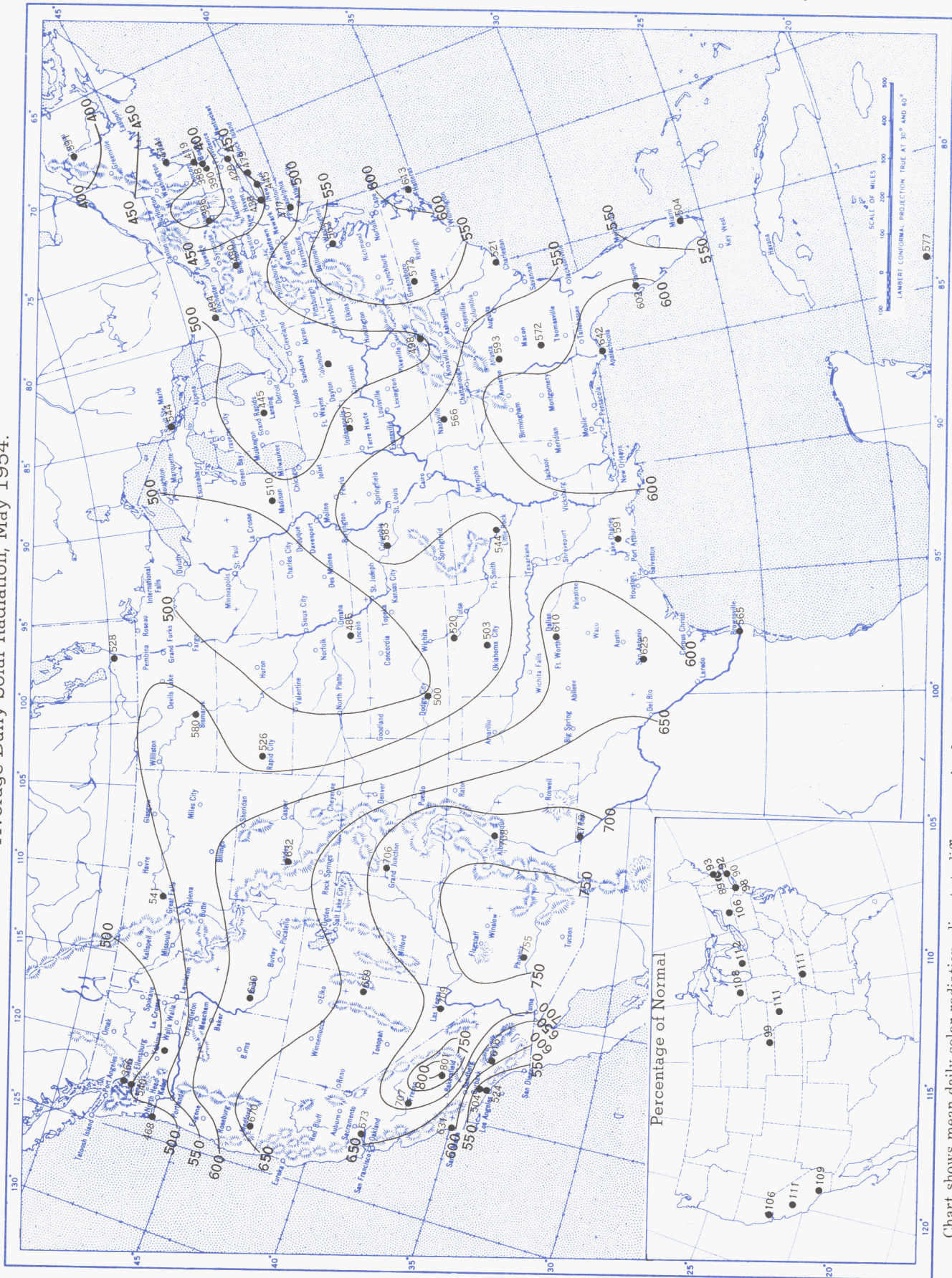


Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langley's (1 langley = 1 gm. cal. cm. ⁻²). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown. Normals are computed for stations having at least 9 years of record.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, May 1954.

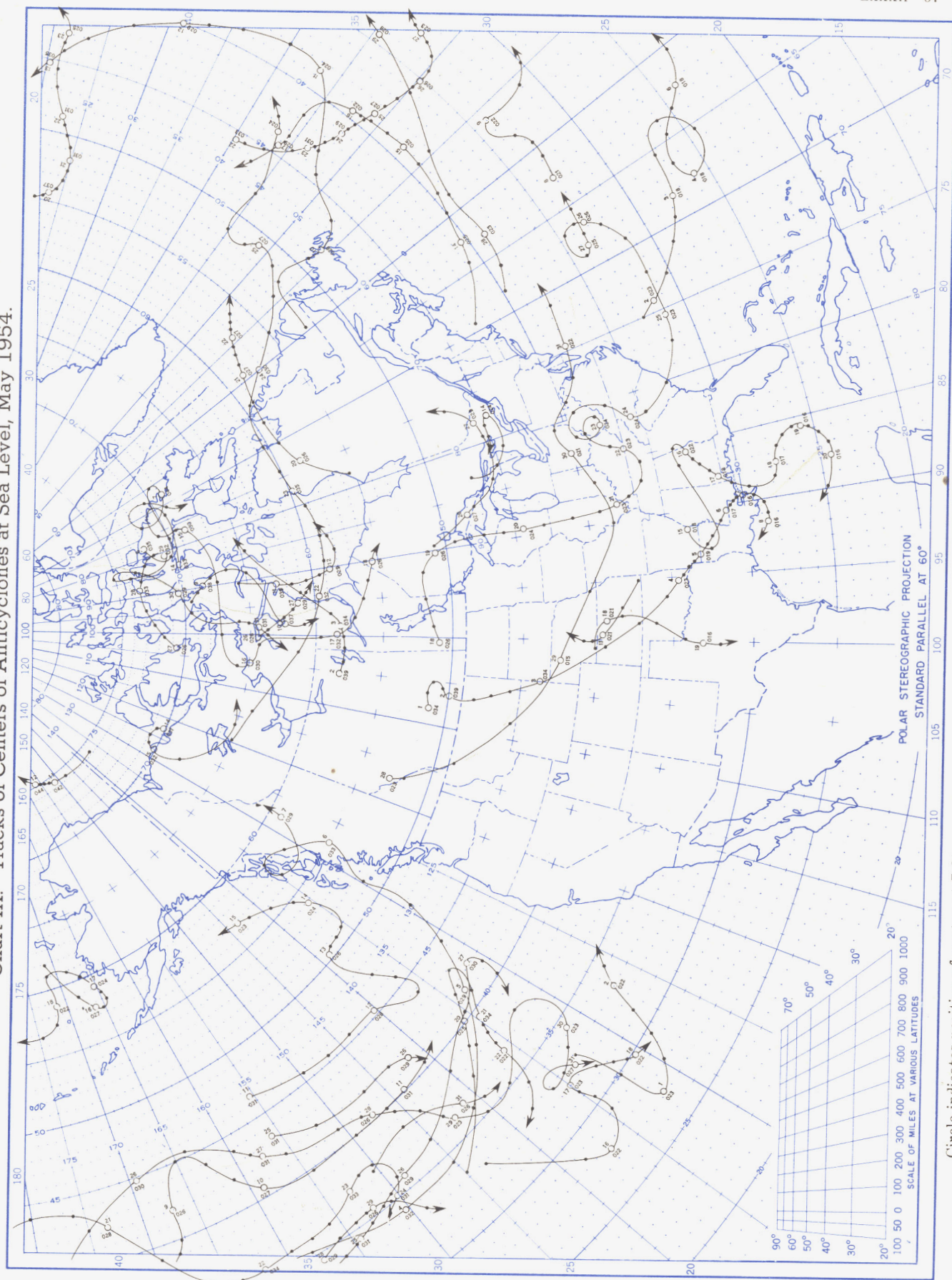
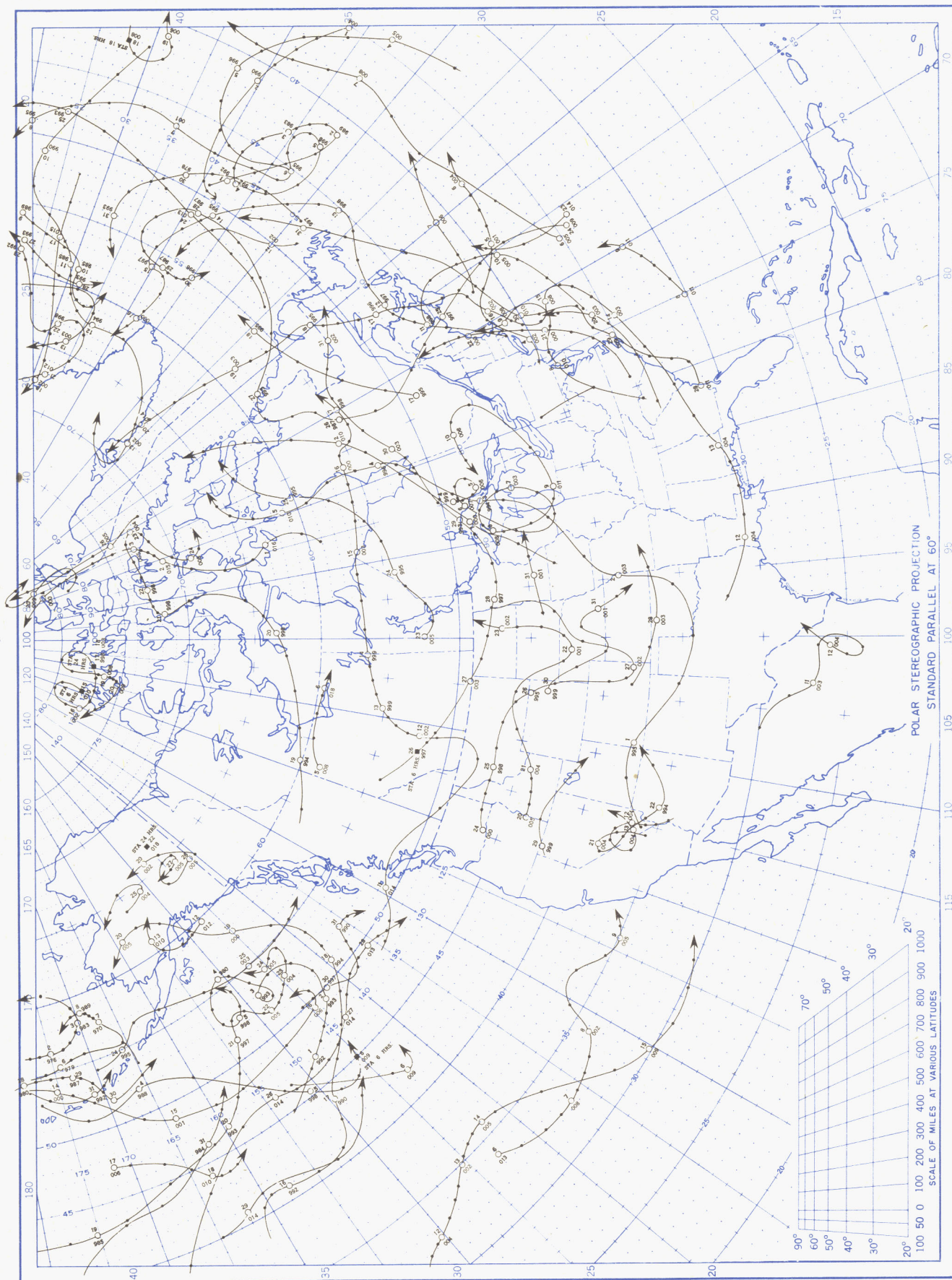
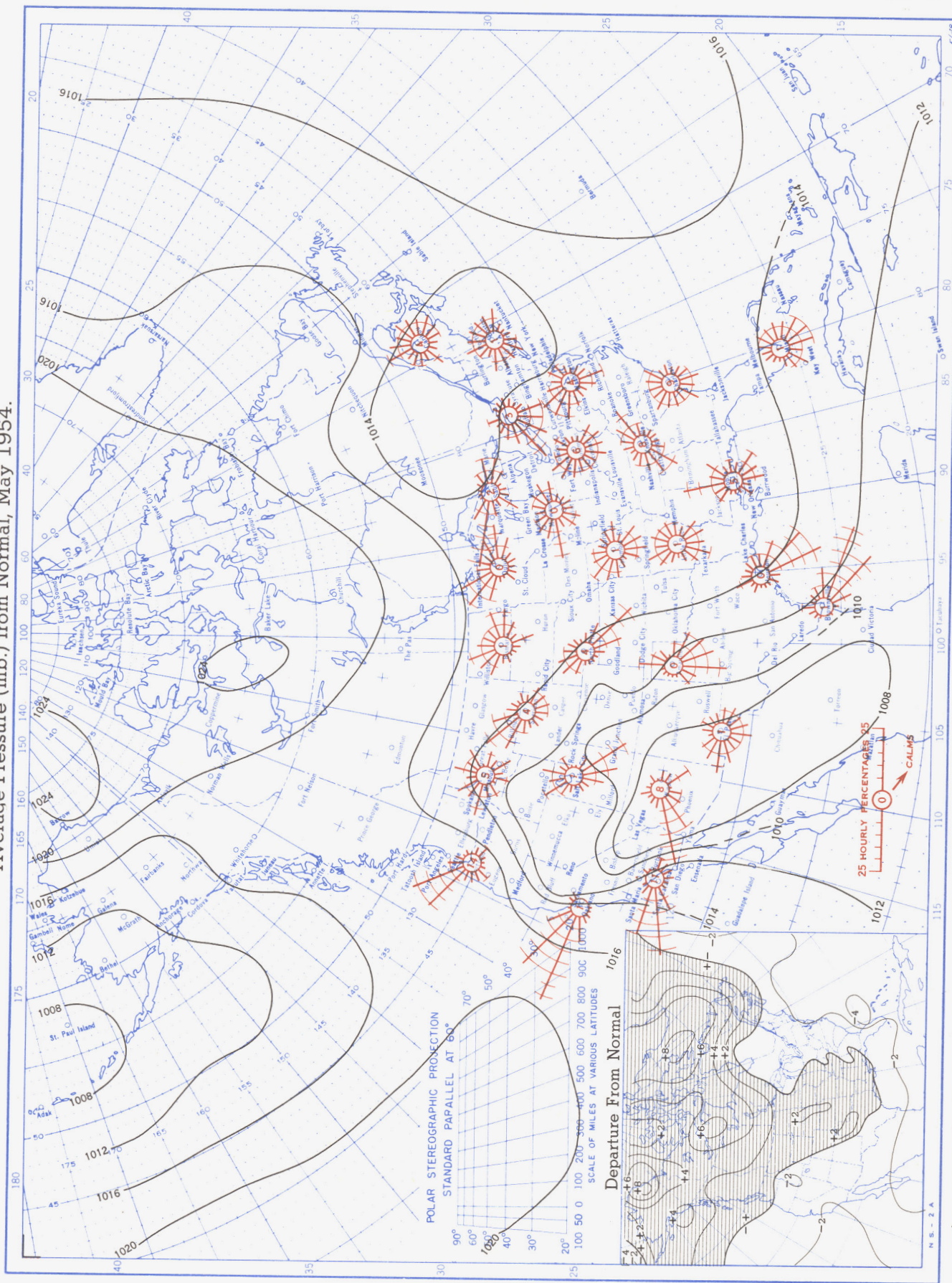


Chart X. Tracks of Centers of Cyclones at Sea Level, May 1954.



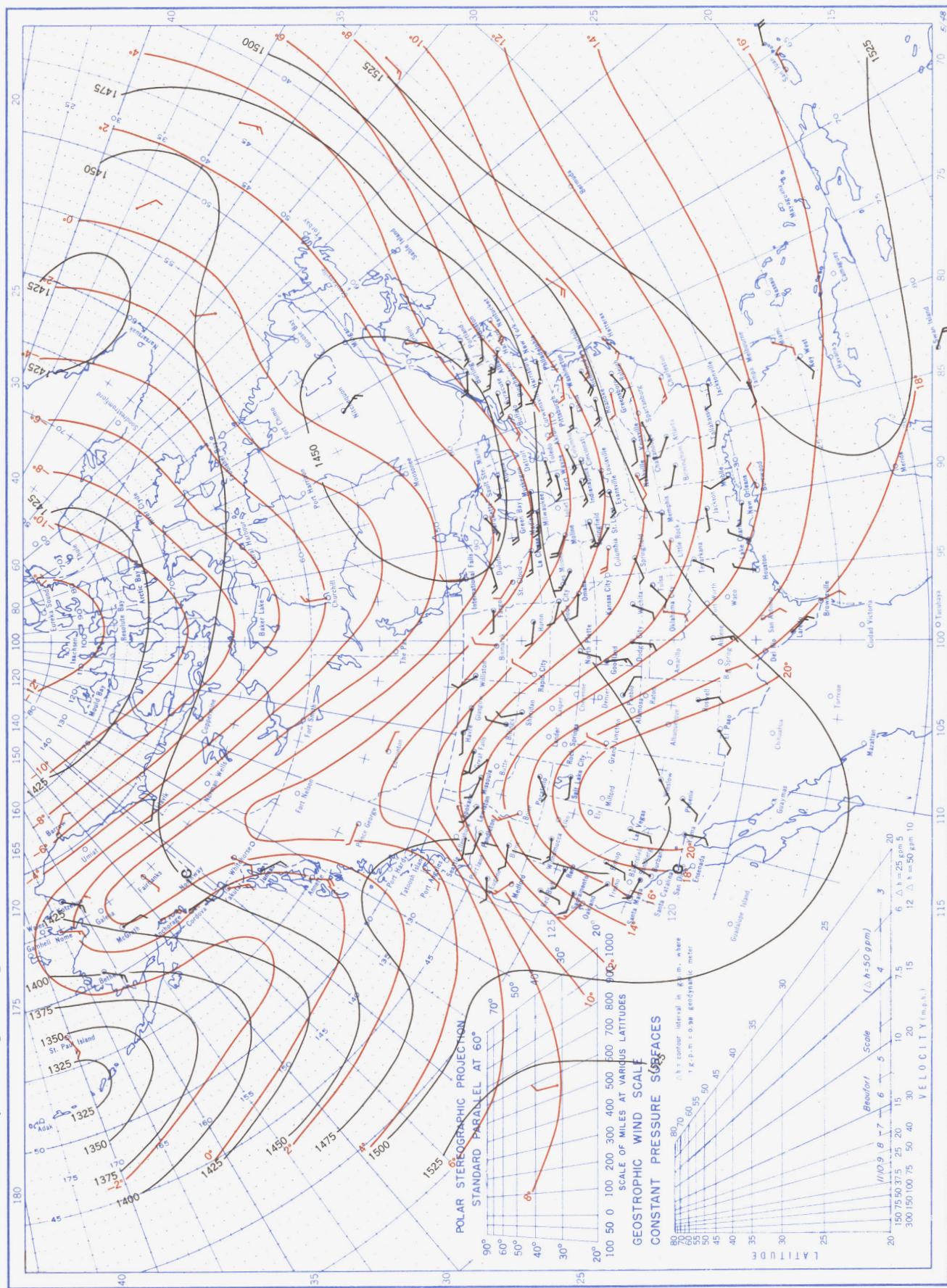
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, May 1954. Inset: Departure of Average Pressure (mb.) from Normal, May 1954.



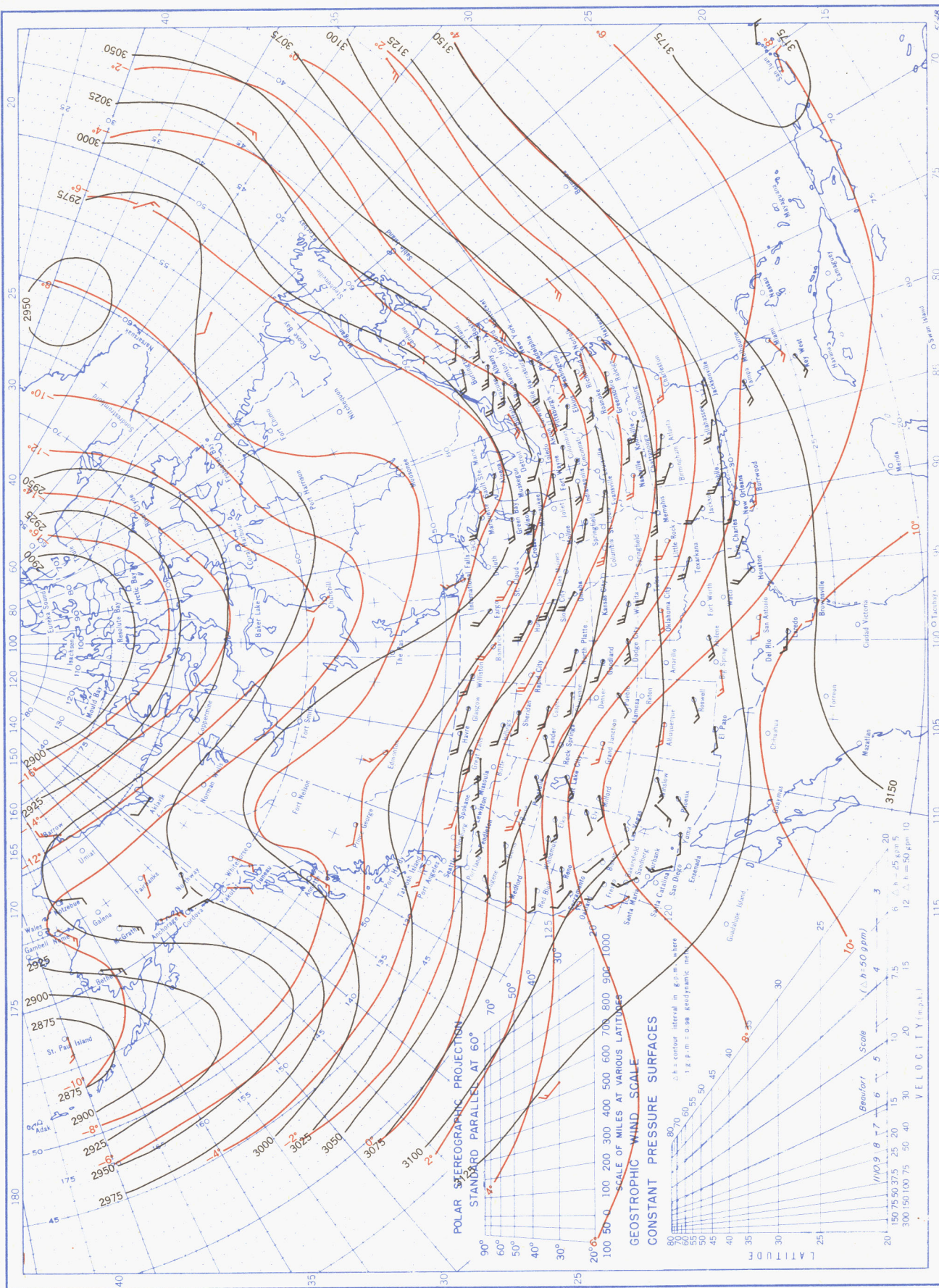
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° inter-sections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), May 1954.



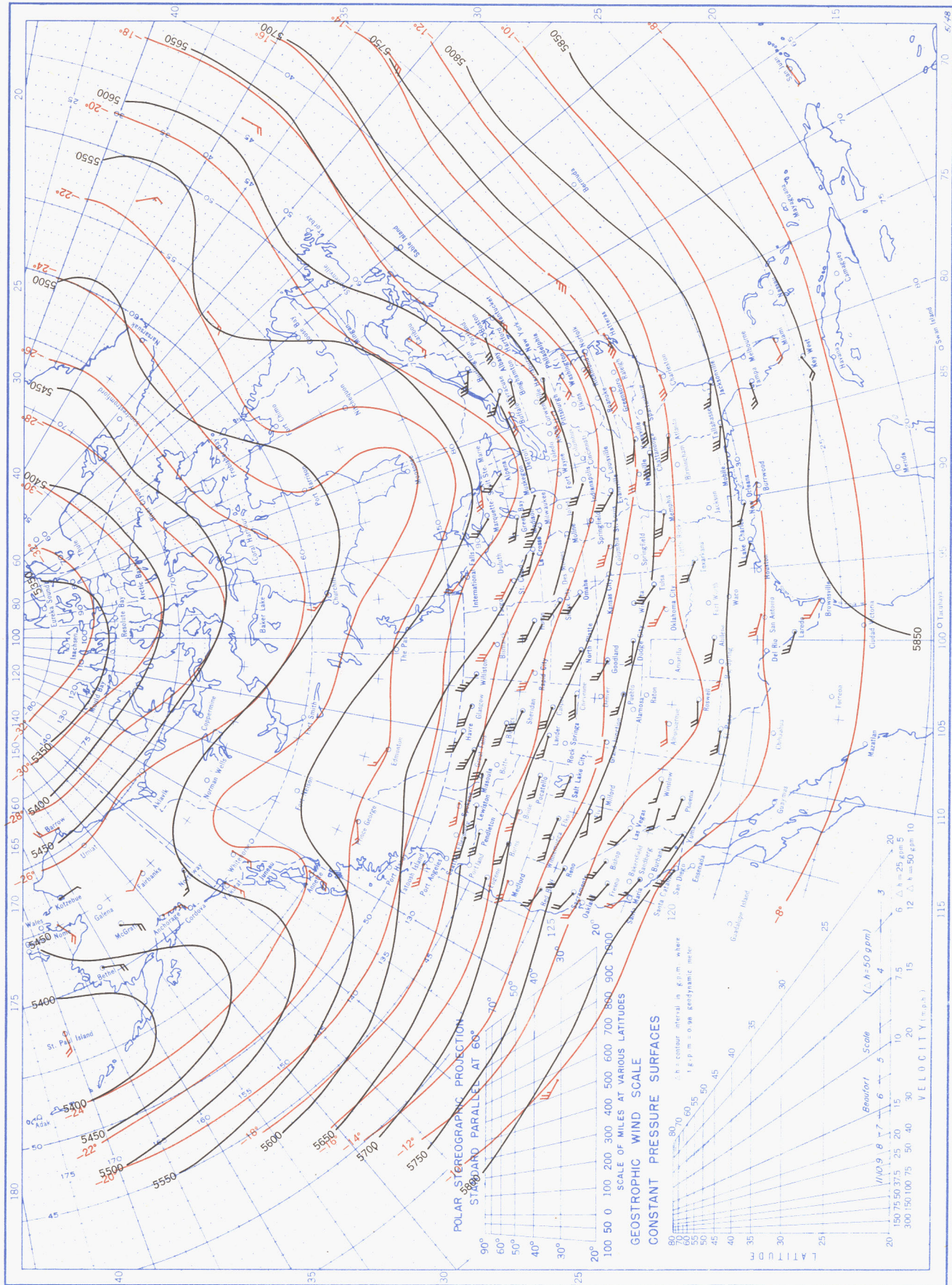
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), May 1954.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), May 1954.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

